Appendix 5.3-B

Benthic Macroinvertebrate Community Assessment 2002

Benthic Macroinvertebrate Community Assessment

CAPE WIND ENERGY PROJECT

Cape Wind
Energy for Life.

PREPARED FOR Cape Wind Associates
75 Arlington Street
Boston, MA

PREPARED BY ESS Group, Inc.
888 Worcester Street, Suite 240
Wellesley, Massachusetts 02482

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TABLE OF CONTENTS

1.0 INTRODUCTION

During late spring 2002, ESS Group Inc. (ESS) conducted an assessment of the benthic macroinvertebrate community on three alternative wind farm sites in Nantucket Sound: Horseshoe Shoal, Monomoy/Handkerchief Shoal and Tuckernuck Shoal. These sites are shown as Alternatives I through III, respectively, on Figure 1. The information presented herein builds on results previously reported from the late summer 2001 benthic sampling round (labeled as BG series in the attached figures), which focused specifically on Horseshoe Shoal.

Each of the three study areas was evaluated with consideration for specific habitat variables such as water depth, sand wave presence (Figure 1), and sediment type (Figures 2-4), which are generally accepted as the primary factors influencing benthic community abundance and diversity in Nantucket Sound (Theroux and Wigley 1998, Zajac 1998). Information reviewed to characterize conditions across the three areas included published charts and reports (NOAA Navigation Chart #13237, O'Hara and Oldale, 1987), as well as results of geophysical surveys conducted by Ocean Surveys Inc. (OSI) during 2001 and classification of surficial marine sediments from vibracores, borings and benthic grab samples collected during 2001 and 2002 (see Section 2.1).

Based on the 2001 field surveys, data indicated that Horseshoe Shoal is characterized by water depths of 8-60 feet, medium and fine sand, and sand wave coverage over approximately 50% of its area. The Monomoy/Handkerchief Shoal area (hereafter Monomoy Shoal) is characterized by depths of 19-43 feet, fine sand, and minimal sand waves. The Tuckernuck Shoal area, is characterized by depths of 4-66 feet, medium sand to fine sand and silt, and is expected to have sand waves over approximately 50% of its area. It should be noted that the delineation of sand waves in the latter two study areas is based upon United States Geological Survey (USGS) field information collected in the 1970s (see Figure 1).

The purpose of the second benthic assessment during the spring of 2002 (labeled as A series on the attached figures and tables) was to evaluate benthic community similarities and differences among the three alternative sites, as well as to assess how the community might vary seasonally as compared with data collected on Horseshoe Shoal during the summer of 2001.

2.0 METHODS

The information presented in this report was designed to build upon the 2001 study performed at Horseshoe Shoal (ESS 2001). Consequently, the collection methods and data analysis employed have remained essentially unchanged from the 2001 study (ESS 2001). One significant change in methodology included an additional analysis of invertebrates from sediment depths > 5 cm. This change was implemented at the request of the U.S. Environmental Protection Agency (USEPA) and the U. S. Army Corps of Engineers (USACE) for the 2002 study, to ensure that all organisms present were accounted for, including large shellfish and polychaete worms that might be capable of surviving in sediment depths of more than 5 cm.

During the 2001 assessments, analysis of the benthic samples focused solely on the upper 5 cm of sediment collected from the sampling dredge. This method was employed since it was generally believed that deeper sediment depths would not contain significant numbers of organisms. During 2002, sediment samples were also processed to evaluate the upper 5 cm of sediment, however, to address the request by USEPA and USACE, the portion of each retrieved sample representing sediment depths > 5 cm were sieved through a coarse mesh (0.65 cm) box sieve in order to collect and record any large organisms (clams, polychaetes, etc.) present deeper in the sediment.

2.1 Analysis of Available Geological Data and Selection of Benthic Sampling Locations

At the request of USEPA and USACE, variability in marine geologic substrate conditions was considered in the selection of locations as part of the second round of benthic sampling conducted in June-July 2002 (A series) for the Cape Wind Project. The purpose was to determine whether variability in surface sediment substrate types, as well as water depths, effect benthic diversity and/or abundance in Nantucket Sound.

In 2001, Cape Wind obtained marine geologic, geophysical and benthic information (BG series) specifically within and around Horseshoe Shoal and shoreward toward Cape Cod, Massachusetts. The data included visual and geotechnical classification of shallow sediment samples from 46 vibracores (corresponding with locations for the 2001 benthic grab BG series) and 3 deep GZA borings, and geophysical characterization of the seafloor from magnetometer, side scan sonar, sub bottom profiling and bathymetry information collected by OSI.

Because the 2002 benthic sampling round was planned to include grabs from Horseshoe Shoal (Alternative Site I), as well as Monomoy Shoal (Alternative Site II) to the east-northeast, and Tuckernuck Shoal (Alternative Site III), to the south of Horseshoe Shoal, respectively, available information on geologic conditions across these areas was obtained.

The Cape Wind marine data collected in 2001 on Horseshoe Shoal was evaluated and then compared with geologic and geophysical information collected throughout Nantucket Sound by the USGS over field seasons in 1976 and 1977, as reported in Miscellaneous Field Studies Map MF-1911 entitled "Maps Showing Geology, Shallow Structure and Bedform Morphology of Nantucket Sound, Massachusetts" (O'Hara and Oldale, 1987). The USGS dataset included 20 vibracores and 500 miles of geophysical track lines.

Comparison of the Cape Wind and USGS datasets over Horseshoe Shoal (the only area where the two coincided) indicated general correlation with two specific geologic parameters: 1) the presence or absence of sand waves, and 2) sediment types, as discussed below. The general correlation of these geologic substrate conditions allowed prediction of these parameters across Monomoy Shoal and Tuckernuck Shoal, which had been studied by USGS. The 2002 benthic sample locations were then selected to test the variability of the predicted geologic substrate conditions in the three alternative sites with respect to benthic organism diversity and/or abundance. The influence of water depths on benthic diversity and abundance are discussed in Section 3.0.

2.1.1 Presence or Absence of Sand Waves

Sand waves were identified across Horseshoe Shoal in both the Cape Wind and USGS geophysical datasets (Figure 1). Given that more than two decades separated the collection of the field information, and that sand waves are characteristic of a dynamic shallow water environment, the distribution of sand waves as mapped by Cape Wind (in red) and USGS (in blue) correlated fairly well. It should be noted that the presence of sand waves also correlated well with the shallow bathymetry over Horseshoe Shoal.

The Cape Wind geophysical survey did not extend over Monomoy Shoal or Tuckernuck Shoal. However, the USGS survey did cover each of the three alternative sites and documented sand waves as being present at Tuckernuck Shoal and absent at Monomoy Shoal. Given that a reasonably good correlation was found between the Cape Wind geophysical survey and the USGS survey with respect to the location of sand waves at Horseshoe Shoal, it is reasonable to expect that sand waves would still be minimal or absent at Monomoy Shoal, and that they would probably still be present at Tuckernuck Shoal as depicted by USGS.

To test whether benthic diversity or abundance varied with respect to the presence or absence of sand waves, benthic grab samples collected in 2002 were targeted for sampling as follows:

Horseshoe Shoal (Alternative Site I), based on Cape Wind and USGS surveys:
- 5 samples in sand wave areas: A1-6; A1-7; A1-8; A1-11; A1-13
- 8 samples outside of sand wave areas: A1-1; A1-2; A1-3 (not obtained); A1-4; A1-5; A1-9; A1-10; A1-12

Monomoy Shoal (Alternative Site II), based on USGS survey:
- 10 samples A2-1 through A2-10 all outside of sand wave areas

Tuckernuck Shoal (Alternative Site III), based on USGS survey:
4 samples collected from sand wave areas: A3-1; A3-2; A3-4; A3-7
8 samples collected from outside of sand wave areas: A3-3; A3-5 (not obtained); A3-6; A3-8; A3-9; A3-10; A3-11; A3-12

Results of the benthic sampling and analysis with respect to the presence or absence of sand waves are presented in Section 3.0.

2.1.2 Sediment Types

Prior to the 2002 sampling round, shallow sediment types in the Horseshoe Shoal area were mapped based upon visual descriptions of predominant grain size in shallow samples (uppermost sample or 0-2 feet) and gradation analysis, where available, in the 46 vibracores and borings collected during the 2001 Cape Wind field program. The distribution of sediment types based upon these data, shown on Figure 2, also integrated applicable information from several USGS vibracores located in the vicinity. Because geotechnical analysis was run on sediments composited from the upper several feet of vibracores, emphasis was placed during mapping on the visual classification of predominant grain size in the uppermost sample(s) of each core (0 to 2 feet). The shallow depths correspond most accurately to benthic habitats. The sediments were described using the Unified Soil Classification System (USCS).

Generally, poorly graded sediments containing predominantly medium sand were found in surficial sediments on U-shaped Horseshoe Shoal itself, which opens to the east. The areal extent of medium sand generally corresponded with areas of shallow bathymetry relative to surrounding deeper waters. Fine-grained sands were found in the embayment within the U-shape and in the deeper water portions surrounding the shoal area. Silts were found in deeper waters. This distribution is consistent with a relatively high-energy marine environment typically found over shallow open waters, where finer sediments are winnowed away by current and wave action. The fines then settle out and deposit in the surrounding lower-energy deeper water environments. The distribution of medium grained sediments also correlates with shallower water depths, for the same reason.

No Cape Wind vibracores or borings had been advanced prior to the 2002 sampling round at either the Monomoy Shoal or Tuckernuck Shoal sites. No USGS vibracores were taken at Monomoy Shoal. At Tuckernuck Shoal, only one USGS vibracore was collected (No. 4937) within the area itself; the USGS log indicated the surficial sediments were shelly sands, but grain size was not reported. Therefore, published USGS vibracore data was insufficient at either Monomoy or Tuckernuck Shoal to assist in identifying the predominant sediment types in those areas.

However, surficial deposits were mapped by USGS throughout the three alternative site areas of Nantucket Sound (Figure 10 of O'Hara and Oldale, 1987), using acoustic variations of the seismic reflection geophysical data, as well as the vibracore data. These data, which also can be interpreted as representing depositional environments, are shown on Figure 3. Two units of surficial geology (Qb and Qfe listed below) correlated fairly well with the mapping of medium and fine-grained sands, respectively, over Horseshoe Shoal (shown on Figure 3). This general correlation within the Horseshoe Shoal area allowed extrapolation of sediment types to areas mapped by USGS as Qb and Qfe at the Monomoy and Tuckernuck Shoal sites. The three predominant types of surficial geologic deposits mapped by USGS across the three Alternative Sites under consideration were:

- Marine beach and bar deposits (Qb)
- Fluvial and estuarine deposits (Qfe)
- Glacial drift (undifferentiated) (Qd)

The distribution of the marine beach and bar deposits (Qb), as mapped by USGS, correlates generally with the distribution of medium sands and the shallow depths that were mapped using the recent data on Horseshoe Shoal. Marine beach and bar deposits are characteristic of a higher energy environment, as are medium sands relative to finer sands. The correlation indicates that medium sands may be found in other areas mapped as Qb by USGS. Additionally, fluvial and estuarine deposits (Qfe) mapped by USGS generally correlate with areas of finer sands on Horseshoe Shoal. Glacial drift deposits (Qd) generally correspond to deeper water areas where sediments have not been actively reworked by fluvial processes. Therefore, the delineation of surficial geology, as mapped by USGS, was used to assign predicted sediment types to Alternative Sites II and III, in the absence of available field data in those areas.

To test the hypothesis of whether benthic diversity or abundance depended or varied with respect to sediment type, the locations of benthic grab samples collected in 2002 were targeted for sampling, in order to reflect predicted sediment types, as follows:

Horseshoe Shoal (Alternative Site I):
8 samples in medium sands: A1-2; A1-3 (not obtained); A1-4; A1-5; A1-6; A1-8; A1-9; A1-13
5 samples in fine sands/silts (4 samples): A1-1; A1-7; A1-10; A1-11; A1-12;

Monomoy Shoal (Alternative Site II):
7 samples in medium sands (Qb deposits): A2-1; A2-2; A2-4; A2-5; A2-6; A2-8; A2-9
3 samples in fine sands/silts (Qfe or Qd deposits): A2-3; A2-7; A2-10

Tuckernuck Shoal (Alternative Site III):
9 samples in medium sands (Qb deposits): A3-2; A3-3; A3-4; A3-6; A3-7; A3-8; A3-9; A3-10; A3-11
3 samples in fine sands/silts (Qfe or Qd deposits): A3-1; A3-5 (not obtained); A3-12

The distribution of sediment types integrating the A series data is shown on Figure 4. At Monomoy Shoal, grain sizes were finer than predicted. Fine sand predominated on the west side of the area, with silt predominating on the east side and corresponding to deeper bathymetry relative to the shallower western area. Medium sand was not predominant in any of the samples collected.

At Tuckernuck Shoal, medium to coarse sands were identified in two samples (A3-3 and A3-6), which were both in areas with the shallowest water depth in that area. These locations were predicted as having medium sands.

Results of the benthic sampling and analysis with respect to the presence or absence of sediment types are presented in Section 3.0.

2.2 Field Collection of Benthic Grab Samples

One surface benthic grab sample was obtained from 33 of the 35 pre-determined locations (Figure 4). Samples were not obtained from two locations, A1-3 and A3-5, possibly due to the presence of hard-bottom or larger sized substrates at these locations. Sample locations were selected to be representative of the range of depths, sediment types and sand wave conditions predicted within each of the three alternative sites being evaluated. The sampling program was designed to allow statistical comparisons to be made among these parameters and benthic organism diversity. Based on communication with USEPA, it was agreed that a minimum of 6 samples would be required within each of the three alternate sites to effectively assess any potential differences in the benthic community among alternate sites. Additionally, it was also agreed that in order to assess the effects of key habitat variables (e.g. depth, substrate type and sand wave presence) on the benthic community, it would be necessary to evaluate a minimum of 6 samples from each key variable.

Samples were collected from a TG&B Marine Services, Inc. survey vessel between June 28th and July 3rd, 2002. The survey vessel was anchored at each sample location, and sample positions were recorded using a Differential Global Positioning System (DGPS) unit. The benthic samples were collected in a manner consistent with the collected made during the summer 2001 survey (ESS 2001). One minor difference was that a Ponar grab sampler was used throughout the 2002 study rather than the Van Veen grab sampler that was employed during 2001, however, all data are reported in numbers of organisms per square meter of bottom area sampled. In addition, the area of bottom collected from each dredge was relatively similar (72 in^2 for the Van Veen sampler and 81 in^2 for the Ponar sampler). The Ponar grab sampler was deployed in a similar fashion to the Van Veen and sampled the sediment in the same way, i.e. the jaws of the sampler were released by a trigger mechanism, trapping a sample of the bottom inside. The sampler was then brought back on deck for field logging and sampling.

Field personnel generated descriptions of each sample's sediment characteristics, the water depth at which it was collected and made notes on the sediment volume removed from the dredge. Subsequent to this, the benthic grab sample (the top 5 cm of material in the dredge) was processed and preserved as during the 2001 study (ESS 2001). All preserved benthic samples were delivered to ESS' laboratory for subsequent analysis.

Following removal of the benthic grab sample (the top 5 cm of material) from the dredge, the remaining sediment was sieved through a coarse mesh box sieve with a mesh size of 0.65 cm. The debris and organisms retained on the box sieve represented the benthic community living in sediments at depths greater than 5 cm. Photographs were taken of the material retained on the sieve for each sample, although several samples did not have any debris or organisms retained. Labels recording the sample location code and the date of sample collection were photographed along with each sample to assist with their subsequent analysis. A representative sample of each benthic organism retained on the box sieve was preserved in a 10% formalin solution and stored in a clearly labeled plastic bag. These organisms were delivered to ESS' laboratory for identification.

2.3 Laboratory Analysis of Benthic Samples

The methods for sorting, identifying and preserving benthic samples were consistent with those performed and reported in the 2001 study (ESS 2001). Taxonomic keys used to assist in identification included Gosner 1978, Meinkoth 1998, Martinez 1999, Smith 1964 and Weiss 1995. Organisms that were not identified during the 2001 study were added to the ESS taxonomic reference collection that has been compiled to include all organisms identified during the two-year study of Nantucket Sound. All quality assurance and quality control (QA/QC) for the sorting and identification phases of lab analysis were completed as reported in the 2001 study (ESS 2001).

In addition to sorting and identifying organisms associated with each benthic sample, laboratory analysis also included the inspection of photographs of the debris retained on each sample's respective box sieve (organisms or material found at depths > 5 cm). Organisms clearly visible on the sieve were identified to the lowest taxonomic level possible. Those organisms too small to identify were recorded as descriptively as possible. The presence of any debris was also described for each sample. Where a large amount of debris covered the sieve, an estimate of the percentage of sieve covered was recorded. A representative sample of each benthic organism retained on the box sieve was identified down to the lowest taxonomic level possible using a dissecting microscope. The confirmed identities of these organisms aided in the identification of organisms from the photographs.

3.0 RESULTS

The sampled benthic communities of Horseshoe Shoal, Monomoy Shoal and Tuckernuck Shoal were composed of a variety of organisms including worms, snails, clams and crustaceans. A total of 71 benthic macroinvertebrate taxa from 10 Classes were recorded in the samples analyzed from the 33 sampled sites (Figure 4). A complete list of benthic organisms identified throughout the 2002 study is presented in Table 1. On average, Tuckernuck Shoal had the lowest macroinvertebrate abundance (organisms/m^2) and diversity (as measure by the number of taxa per sample). Monomoy Shoal had the highest average macroinvertebrate diversity but a lower average abundance than Horseshoe Shoal. A complete summary of the macroinvertebrate community statistics for each of the three alternative areas is presented in Table 2.

Over the three alternative areas combined, 3 of the 71 total taxa found, accounted for 80% of the organisms collected and 30 taxa (or less than half) accounted for greater than 98% of the organisms collected (Table 3). Overall, the most dominant taxon was found to be Nematoda, followed by Ampeliscidae (four-eyed amphipod).

The top six most dominant taxa for each alternative area sampled in spring 2002 and for Horseshoe Shoal sampled in summer 2001, are presented in Table 4. For each of the three areas sampled in spring 2002 the six dominant taxa represent over 90% of the community, compared to 75% at Horseshoe Shoal in summer 2001. This may indicate that the life cycles of a few organisms appear to have allowed them to dominate the benthic community of all three alternative sites during the spring of 2002.

The six dominant taxa for Monomoy, Tuckernuck and Horseshoe Shoal in spring 2002 were very similar, with Nematoda being the most dominant taxon at each location (Table 4). However, nematodes formed a much greater percentage of the community in the Tuckernuck Shoal area with 80.9% compared to 50.1% and 45.3% at the other two. A high percent contribution by a single taxon generally indicates community imbalance and possibly a stressed environment (Gibson et. al 2000).

The six dominant taxa at Horseshoe Shoal were markedly different in the spring of 2002 compared to the late summer of 2001 (Table 4). Nematoda were much less dominant in the summer and two snail species *Crepidula convexa* and *Crepidula fornicata* ranked highly in the top six during the summer but did not appear in the top six during spring. In addition, three crustacean families ranked in the top six dominant taxa during summer 2001 as opposed to two in spring 2002.

The benthic organisms recorded from sediment depths greater than 5 cm are presented in Table 5. It is recognized that some of these organisms are not typical of deep sediments and are likely to have been incorporated with deep sediment organisms as a result of residual sediment from the upper 5 cm of the dredge being passed through the sieve. Despite the addition of these residual organisms, very few organisms were observed at any site in sediment depths greater than 5 cm. This validates the data collected during the 2001 study that analyzed only the top 5 cm of sediment, although it is recognized that samples collected in near shore areas may not yield similar results. More importantly, this analysis also reveals that the majority of benthic organisms living at Horseshoe, Monomoy and Tuckernuck shoals, including the larger shellfish and polychaetes, live in the top 5 cm of sediment. This may be due to the nature of these areas's shifting sediments, which would have a greater potential to bury organisms that were deeply embedded or sedentary (Rhodes et al. 1978, Sanders 1956).

3.1 Statistical Analysis

A primary goal of this study was to evaluate the following five null hypotheses:

1. Benthic community diversity (number of taxa per sample) and/or abundance (number of organisms per square meter of bottom area) do not differ among the 3 alternative sites in the spring 2002 sampling survey.
2. Benthic diversity and/or abundance do not differ among three pre-selected depth ranges (5-20 feet, 20-30 feet, 30 or more feet) in the spring 2002 sampling survey.
3. Benthic diversity and/or abundance do not differ among the identified surface sediment substrate types in the spring 2002 sampling survey.
4. Benthic diversity and/or abundance do not differ with the presence or absence of sand waves in the spring 2002 sampling survey.
5. Benthic diversity and/or abundance on Horseshoe Shoal do not differ between summer 2001 and spring 2002.

A summary of the statistical analysis performed for each of these null hypotheses is presented in Table 6. The α value for this analysis was set at 0.10 for all calculations, i.e. when the P-value is equal to or less than 0.10 then there is a significant difference and the null hypothesis would be disproved. Analysis of variance (ANOVA) results for each hypothesis tested are presented in Appendix 1.

The following is a summary of the analytical results of the null hypothesis tests:

1. Benthic diversity *was significantly different* among some of the 3 alternative sites in the spring 2002 sampling survey (Table 6). Specifically, benthic diversity was significantly higher on Monomoy Shoal than on Tuckernuck Shoal while no significant difference was found between the benthic diversity of Horseshoe Shoal and either of the two other alternative areas assessed. Macroinvertebrate abundances did not differ significantly among the three alternative sites (Table 6).

2. Benthic diversity *was significantly different* between some of the pre-selected depth ranges (Table 6). Specifically, macroinvertebrate diversity was significantly higher in samples collected at depths of 5-20 ft (shallow water) than those collected from a depth of 21-30 ft (mid-depth). Macroinvertebrate abundances did not differ significantly among the three depth ranges evaluated (Table 6).

3. Benthic diversity *was significantly different* among surface sediment types (Table 6). Although the benthic community abundances did not differ significantly between fine grained and coarser grained substrates, sampling during 2002 revealed that macroinvertebrate diversity was significantly higher in fine sediments as compared with medium or coarse-grained sediments.

4. Benthic diversity and abundance *were significantly different* with respect to the presence or absence of sand waves. In particular, macroinvertebrate diversity and abundance were both significantly higher in areas not characterized by sand waves (Table 6).

5. Benthic community abundance *was not significantly different* on Horseshoe Shoal during the late summer 2001 sampling period versus the spring 2002 sampling period (Table 6). In addition, macroinvertebrate diversity was also *not significantly different* between the dates.

4.0 CONCLUSIONS

Overall species composition documented as part of this study and the 2001 study was consistent with data reported in earlier studies of Nantucket Sound, Georges Bank, and the Southern New England Shelf (Sanders 1956, Wigley 1968, Pratt 1973, Theroux and Wigley, 1998). These previous studies found the benthic community of Nantucket Sound to have a lower than average invertebrate diversity as compared to the rest of the Southern New England Shelf. However, density and biomass was found to be relatively high. This is not surprising, as it is understood that only a limited number of taxa are capable of withstanding the shifting, sandy substrates characteristic of these shallower waters. Consequently, these habitats are able to support greater densities of each successfully adapted organism.

In addition, there is natural variability in most benthic communities since these communities are constantly subjected to a combination of physical and biological factors which results in a high degree of environmental variability (Sanders 1956, Zajac 1998). It also follows that a high sample-to-sample variability was found in total invertebrate abundance. This supports the conclusion of earlier research that also revealed the benthic community of Nantucket Sound to be highly variable from season to season and location to location (Wigley 1968). It is believed that the patchy nature of "microhabitats" (defined as, the specific combination of habitat elements in the place occupied by an organism for a specific purpose) in terms of such parameters as depth, substrate type, temperature, light penetration, food availability, shelter, disturbance, currents, and predation, could be the reason for such variability (Sanders 1958, NAI 1979, DeLeuw et al. 1991, Howes et al. 1997).

The relatively limited number of samples collected for this assessment found that there was an obvious link between depth, sediment type and macroinvertebrate community diversity. However, the data also showed that there was no such link between these variables and overall macroinvertebrate abundance. The only microhabitat variable investigated that was shown to significantly affect macroinvertebrate abundance was the presence or absence of sand waves. The unstable sand wave environment was predominantly inhabited by more motile organisms capable of avoiding the shifting sands (e.g. the Amphipod Hostoriidae, the Tanaid Leptognathia caeca) or by organisms that could burrow out from beneath them once they became buried (e.g. the Bivalve Tellina agilis, Nematoda, Oligochaeta, or a number of the Polychaeta). Interestingly, Tellina agilis was the only shellfish (bivalve or gastropod) that was found in any sample taken from a sand wave. Gosner (1978) describes Tellina agilis as a mobile and actively burrowing bivalve.

With regard to the selection of a preferred site for the siting of the Wind Farm, the Monomoy Shoal location appears to be less desirable, at least from a benthic community standpoint, since its benthic community was the most diverse of the three alternate sites evaluated. Tuckernuck Shoal and Horseshoe Shoal were similar, statistically, with respect to both macroinvertebrate diversity and abundance. This may be a result of the similarity of habitat in each of these areas. Given this similarity, either site would be equally suitable as a location for the Wind Farm.

5.0 REFERENCES

DeLeuw, Cather, & Company. 1991. Technical Memorandum #8, An inventory of Selected Aquatic and Biological Resources in the vicinity of the Quinnipiac River Bridge.

ESS. 2001. Cape Wind Energy: Benthic Macroinvertebrate Community Assessment, October 2001.

Gallagher, E.D. and K.E. Keay. 1998. Organism-Sediment-Contaminant Interactions in Boston Harbor. Pp. 89-132 in K.D. Stolzenbach and E.E. Adams, eds. Contaminated Sediment in Boston Harbor. MIT Sea Grant Press. 170 pp.

Gibson, G.R., M.L. Bowman, J. Gerritsen, and B.D. Snyder. 2000. Estuarine and coastal marine waters: bioassessment and biocriteria technical guidance. EPA 822-B-00-024. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Gosner, K.L. 1978. The Peterson Field Guide Series. A Field Guide to the Atlantic Seashore From the Bay of Fundy to Cape Hatteras. Houghton Mifflin Company.

Howes, B.L., D.R. Schlezinger, J.A. Blake, and D.C. Rhoads. 1997. Infaunal "recovery" as a control of sediment organic matter remineralization and the fate of regenerated nutrients in Boston Harbor: 14th Biennial Estuarine Research Federation (ERF) International Conference - The State of Our Estuaries. Oct. 12-16, Providence, R.I. Abstracts; p. 84.

Martinez, A.J. 1999. Marine Life of the North Atlantic, Canada to New England. Down East Books.

Meinkoth, N.A. 1998. National Audubon Society Field Guide to North American Seashore Creatures. Alfred A. Knopf. Inc.

Ocean Surveys, Inc. July 2002. Marine Geophysical Survey and Sediment Sampling Program: Cape Wind Energy Project, Nantucket Sound, Massachusetts. Prepared for Environmental Science Services, Inc.

O'Hara, Charles J. and Oldale, Robert N. 1987. Geology, Shallow Structure, and Bedform Morphology, Nantucket Sound, Massachusetts. 1:125,000. United States Geological Survey Miscellaneous Field Studies Map MF 1911.

Pratt, S.D. 1973. Benthic fauna. Pages 5-1 to 5-55 In: Coastal and Offshore Environmental Inventory. Cape Hatteras to Nantucket Shoal. Marine Publication Series No. 2. University of Rhode Island, Kingston, RI.

Rhoads, D.C., P.L. McCall, and J.Y. Yingst. 1978. The ecology of seafloor disturbance. *Am. Sci.* 66: 577-586.

Sanders, H. L. 1958. Benthic studies in Buzzards Bay. I. Animal-sediment relationships. Limnol Oceanogr 5:138-153.

Sanders, H.L. 1956. Oceanography of Long Island Sound. X. The Biology of marine bottom communities. Bulletin Bingham Oceanography collection 15: 245-258.

Smith. R.I. 1964. Keys to the Marine Invertebrates of the Woods Hole Region. Marine Biological Laboratory.

Theroux, R.B., and Wigley, R.L., 1998, Quantitative composition and distribution of the microbenthic invertebrate fauna of the continental shelf ecosystems of the northeastern United States, National Oceanographic and Atmospheric Administration Technical Report NMFS 140, 240 p.

Weiss. H.M. 1995. Marine Animals of Southern New England and New York. Identification Keys to Common Nearshore and Shallow Water Macrofauna. Bulletin 115 of the State Geological and Natural History Survey of Connecticut. Department of Environmental Protection.

Wigley, R. 1968. Benthic Invertebrates of the New England Fishing Banks, in "Underwater Naturalist", American Littoral Society, Vol. 5, No. 1.

Zajac, R.N. 1998. A review of research on benthic communities conducted in Long Island Sound and an assessment of structure and dynamics. Chapter 4 in Long Island Sound Environmental Studies, U.S. Geological Survey Open-File Report 98-502.

Tables

Table 1. Macroinvertebrate sampling data for selected sites on the Horseshoe Shoal, Monomoy Shoal and Tuckernuck Shoal, Spring, 2002.

	Number of Individuals m^2- Horseshoe Shoal												Number of Individuals per m^2- Monomoy Shoal										Number of Individuals per m^2- Tuckernuck Shoal										
Taxa	**A1-1**	**A1-2**	**A1-4**	**A1-5**	**A1-6**	**A1-7**	**A1-8**	**A1-9**	**A1-10**	**A1-11**	**A1-12**	**A1-13**	**A2-1**	**A2-2**	**A2-3**	**A2-4**	**A2-5**	**A2-6**	**A2-7**	**A2-8**	**A2-9**	**A2-10**	**A3-1**	**A3-2**	**A3-3**	**A3-4**	**A3-6**	**A3-7**	**A3-8**	**A3-9**	**A3-10**	**A3-11**	**A3-12**
Bivalvia																																	
Anadara transversa	114		38														76																
Astarte castanea																	76																
Crassostrea virginica			76																														
Macoma balthica																									76								
Natica pusilla			38																														
Nucula proxima	114										76																						
Pandora gouldiana																76					76												38
Tellina agilis			38	19		152	76		304	38			912	152	38	152	38	76			38	76			114		380		38		38	38	
Yolidia limatula															38				38														
Crustacea																																	
Amphipoda																																	
Ampeliscidae			38								33060		76		684	418	38	532	1748	9424	684	7296	38									76	152
Ampithoidae															228																		
Aoridae		114	38	209							4484				380					532	38	456											
Caprella penantis	228	190	114													38																	
Corophiidae	190																		152				76									114	
Haustoriidae				38																				456				76	38			38	
Phoxocephalidae	38	38	114			76			228							76	76															38	
Pontogeneia inermis		114																															
Unicola Spp.																								38									
Decapoda																																	
Cancer irroratus													76																				
Carcinus maenas											152							38															
Dyspanopeus sayi	38	38	38																														
Ovalipes ocellatus																38																	
Pinnixa spp.																							76										
Isopoda																																	
Sphaeromatidae																									38								
Tanaidacea																																	
Leptochelia savignyi										76																						304	
Leptognathia caeca																												266					
Gastropoda																																	
Acteocina canaliculata																				76													
Caecum johnsoni													76														798						
Caecum pulchellum																	38																
Crepidula fornicata	760	38															228																
Crepidula plana	76																																
Hydrobia totteni				57							304																						
Mitrella lunata	114		152													38	114																
Odostomia seminuda	380																																
Seila adamsi	152																38																
Urosalpinx cinerea																	76																
Nematoda	3268	2166	2546	1862	3648	4978	9120	14060	3344	190	1292	2812	10336	9880	190	7334	912	3724	418	76	2432	152	1976	874	7828	2432	5890	1444	2926	16568	114	342	418
Nemertea	76		304		38	38	76				152					152									228	152						38	
Oligochaeta	4142		228						342	38	4332		228	76	532		684	342	76	380	76	228	114	76	190	76	228		76	76	114		456
Polychaeta																																	
Aglaophamus neotenus																													38				
Ampharete acutifrons	76	38	76								76			76	38	114		228			152		38										76
Aricidea sp.						76									114	380		114						76								76	
Capitellidae		38										608		76	114						38												
Cirratulus grandis	76													76									38										
Clymenella sp.		38				76			38						570	38							114	76			38						
Enoplobranchus sanguineus													152																				
Eteone sp.	228		114								76						266																
Flabelligera affinis															38																		
Glycera dibranchiata					228			456		38		304													228	608	38		38	228			
Hartmania moorei			76																														
Lepidonotus squamatus	76		38								76						38																
Magelona rosea						38												38						266								38	
Melinna cristata		38												76																			
Nephtys picta			38	19					152				76	152	38	76		114		76				76						76			
Nereis pelagica									76																								
Ophelia limacina		38																															
Orbinia ornata																														76			
Pectinaria gouldii																	38																
Polycirrus sp.													228																				
Polyphysia crassa		114	38	19							76						38																
Pygospio elegans																																	38
Scoloplos sp.					38	38			38																		114		38			38	
Spiochaetopterus oculatus											76				38																		
Spiophanes bombyx	76								38		152	152			190				152				190								152		38
Streblospio benedicti									76						38																		
Syllides spp.	722	494	152	57		76		684				76	1672	380		456		76			114		190			76	456	76		456		114	
Terebella lapidaria																									76								
Tharyx spp.		38														76		76													76		
Polyplacophora																																	
Chaetopleura apiculata	76																114																
Trematoda					38							228																					
Turbellaria																										114							
Total	**11,020**	**3,534**	**4,294**	**2,280**	**3,990**	**5,548**	**9,272**	**15,200**	**4,636**	**380**	**44,384**	**4,180**	**13,832**	**10,944**	**3,268**	**9,462**	**2,888**	**5,358**	**2,584**	**10,564**	**3,648**	**8,208**	**2,850**	**1,938**	**8,778**	**3,458**	**7,942**	**1,862**	**3,192**	**17,480**	**494**	**1,254**	**1,216**
Number of Taxa	**21**	**15**	**20**	**8**	**5**	**9**	**3**	**3**	**10**	**5**	**14**	**6**	**10**	**9**	**16**	**15**	**17**	**11**	**6**	**6**	**9**	**5**	**10**	**8**	**8**	**6**	**8**	**4**	**7**	**6**	**5**	**12**	**7**

Sample A3-5 Lost during shipment
No sample taken at site A1-3 due to
inpenetrable sediment/bivalves

Table 2. Summary statistics for macroinvertebrate data collected from Horseshoe Shoal, Monomoy Shoal and Tuckernuck Shoal, Spring, 2002.

Areas Under Investigation	*n*	Total Taxa Present	Average Number of Taxa per Sample	Average Number of Individuals per m^2
Horseshoe Shoal	12	48	9.9	9,060
Monomoy Shoal	10	46	10.4	7,076
Tuckernuck Shoal	11	32	7.4	4,588

Table 3. Ranked abundances of macroinvertebrate taxa in sediment samples taken from Nantucket Sound, Spring 2002.

Taxon	Average No. Individuals/m^2	% Total	Cumulative %	No. of Sites Present At	% of Sites Present At
Nematoda	3804.6	54.60	54.60	33	100
Ampeliscidae	1644.4	23.60	78.20	14	42
Oligochaeta	397.3	5.70	83.90	23	70
Syllides spp.	191.7	2.75	86.65	18	55
Aoridae	189.4	2.72	89.37	8	24
Tellina agilis	82.3	1.18	90.55	19	58
Glycera dibranchiata	65.6	0.94	91.49	9	27
Nemertea	38.0	0.55	92.04	10	30
Spiophanes bombyx	34.5	0.50	92.53	9	27
Crepidula fornicata	31.1	0.45	92.98	3	9
Ampharete acutifrons	29.9	0.43	93.41	11	33
Clymenella sp.	29.9	0.43	93.84	8	24
Nephtys picta	27.1	0.39	94.23	11	33
Caecum johnsoni	26.5	0.38	94.61	2	6
Capitellidae	26.5	0.38	94.99	5	15
Aricidea sp.	25.3	0.36	95.35	6	18
Phoxocephalidae	20.7	0.30	95.65	8	24
Eteone sp.	20.7	0.30	95.95	4	12
Haustoriidae	19.6	0.28	96.23	5	15
Caprella penantis	17.3	0.25	96.48	4	12
Corophiidae	16.1	0.23	96.71	4	12
Mitrella lunata	12.7	0.18	96.89	4	12
Leptochelia savignyi	11.5	0.17	97.05	2	6
Odostomia seminuda	11.5	0.17	97.22	1	3
Magelona rosea	11.5	0.17	97.39	4	12
Hydrobia totteni	10.9	0.16	97.54	2	6
Scoloplos sp.	9.2	0.13	97.67	6	18
Polyphysia crassa	8.6	0.12	97.80	5	15
Leptognathia caeca	8.1	0.12	97.91	1	3
Tharyx spp.	8.1	0.12	98.03	4	12
Trematoda	8.1	0.12	98.15	2	6
Anadara transversa	6.9	0.10	98.24	3	9
Ampithoidae	6.9	0.10	98.34	1	3
Lepidonotus squamatus	6.9	0.10	98.44	4	12
Polycirrus sp.	6.9	0.10	98.54	1	3
Nucula proxima	5.8	0.08	98.62	2	6
Pandora gouldiana	5.8	0.08	98.71	3	9
Carcinus maenas	5.8	0.08	98.79	2	6
Seila adamsi	5.8	0.08	98.87	2	6
Cirratulus grandis	5.8	0.08	98.96	3	9
Chaetopleura apiculata	5.8	0.08	99.04	2	6
Enoplobranchus sanguineus	4.6	0.07	99.10	1	3
Pontogeneia inermis	3.5	0.05	99.15	1	3
Dyspanopeus sayi	3.5	0.05	99.20	3	9
Melinna cristata	3.5	0.05	99.25	2	6
Spiochaetopterus oculatus	3.5	0.05	99.30	2	6
Streblospio benedicti	3.5	0.05	99.35	2	6
Turbellaria	3.5	0.05	99.40	1	3
Astarte castanea	2.3	0.03	99.43	1	3
Crassostrea virginica	2.3	0.03	99.47	1	3
Macoma balthica	2.3	0.03	99.50	1	3
Yolidia limatula	2.3	0.03	99.53	2	6
Cancer irroratus	2.3	0.03	99.57	1	3
Pinnixa spp.	2.3	0.03	99.60	1	3
Acteocina canaliculata	2.3	0.03	99.63	1	3
Crepidula plana	2.3	0.03	99.67	1	3
Urosalpinx cinerea	2.3	0.03	99.70	1	3
Hartmania moorei	2.3	0.03	99.73	1	3
Nereis pelagica	2.3	0.03	99.76	1	3
Orbinia ornata	2.3	0.03	99.80	1	3
Terebella lapidaria	2.3	0.03	99.83	1	3
Natica pusilla	1.2	0.02	99.85	1	3
Unicola Spp.	1.2	0.02	99.86	1	3
Ovalipes ocellatus	1.2	0.02	99.88	1	3
Sphaeromatidae	1.2	0.02	99.90	1	3
Caecum pulchellum	1.2	0.02	99.91	1	3
Aglaophamus neotenus	1.2	0.02	99.93	1	3
Flabelligera affinis	1.2	0.02	99.95	1	3
Ophelia limacina	1.2	0.02	99.96	1	3
Pectinaria gouldii	1.2	0.02	99.98	1	3
Pygospio elegans	1.2	0.02	100.00	1	3

Table 4. Dominant macroinvertebrate taxa on Horseshoe Shoal, Monomoy Shoal and Tuckernuck Shoal, spring 2002, and on Horsehoe Shoal, summer 2001.

Monomoy Shoal		Tuckernuck Shoal		Horseshoe Shoal		Horseshoe Shoal (2001 Survey)	
Dominant taxa	**% of total community**	**Dominant taxa**	**% of total community**	**Dominant taxa**	**% of total community**	**Dominant taxa**	**% of total community**
Nematoda	50.1	Nematoda	80.9	Nematoda	45.3	Ampeliscidae	26.99
Ampeliscidae	29.5	Oligocheata	2.8	Ampeliscidae	30.4	Ischyroceridae	21.23
Syllides spp.	3.8	*Syllides spp.*	2.7	Oligocheata	8.4	*Crepidula convexa*	9.59
Oligocheata	3.7	*Glycera dibranchiata*	2.3	Aoridae	4.5	*Crepidula fornicata*	8.76
Tellina agilis	2.1	*Caecum johnsoni*	1.5	*Syllides spp.*	2.1	Nematoda	5.01
Aoridae	1.9	*Tellina agilis*	1.2	*Glycera dibranchiata*	0.9	Aoridae	3.32
% of total community represented	**91.1**		**91.4**		**91.6**		**74.9**

Table 5. Macroinvertebrates identified from depths greater than 5 cm, through photographic analysis of sieved samples.

Sample ID	**Organisms Identified**																					**Total # of Organisms Observed**	**Other Notes**
	Clymenella sp.	***Glycera dibranchiata***	***Hartmania moorei***	***Lumbrineris fragilis***	***Nephtys Picta***	***Ninoe nigripes***	**Phyllodocidae**	***Pista cristata***	***Polyphysia crassa***	***Spiochaetopterus oculatus***	**Unidentified Polychaeta**	***Crepidula fornicata***	***Nassarius trivittata***	***Pandora gouldiana***	***Anadara transversa***	***Corbula contracta***	***Crassostrea virginica***	***Yoldia limatula***	***Dyspanopeus sayi***	***Libinia dubia***	***Ovalipes ocellatus***		
Horseshoe Shoal																							
A1-1												2										**2**	2 large clumps + scattered dead crepidula fornicata shells, with seaweed and shell hash
A1-2															1				1			**2**	Large amounts of pebbles, shell hash. 2 large clumps of seaweed.
A1-3												49										**49**	Not clear if all/any are occupied shells.
A1-4												1			1		1					**3**	Scattered seaweed strands, large rocks, shell hash
A1-5					1																	**1**	10 sand tubes - believed to be empty
A1-7	4									1				1								**6**	A little shell hash
A1-8																						**0**	Scattered shell hash
A1-9																						**0**	5 sand tubes believed to be empty. Scattered shell hash
A1-10																						**0**	2 sand tubes believed to be empty. Scattered pebbles and shell hash
A1-11			1																			**1**	Scattered shell hash
A1-12		2																				**2**	~20% coverage of sieve bottom with mud tubes, could contain ampeliscidae as these made up a large % of the sample
A1-13																						**0**	Large quantity of shell hash, a couple of clumps of seaweed.
Monomoy Shoal																							
A2-1																1						**1**	3 sand tubes, believed to be empty. Tiny amount of stone and shell hash
A2-2			1					1			2											**4**	4 sand tubes believed to be empty.
A2-3				1							2											**3**	
A2-5																				1		**1**	Small amount of shell hash and pebbles
A2-8		1									3										1	**5**	Scattered mud tube clumps believed to be empty.
A2-9											4											**4**	Scattered shell fragments and slimy patches.
A2-10											3							1				**4**	Scattered mud fragments
Tuckernuck Shoal																							
A3-1							2															**2**	2 large mud clumps
A3-3																						**0**	Scattered shell hash and pebbles
A3-4																						**0**	Scattered shell hash and pebbles
A3-6			1								1											**2**	1 bamboo worm tube, believed to be empty
A3-9					1																	**1**	
A3-10	1												1									**2**	Not sure if snail shell was occupied.
A3-12						1			1		1											**3**	Tiny amount of shell hash

Table 6. Statistical correlations for macroinvertebrate data collected from Horseshoe Shoal, Monomoy Shoal and Tuckernuck Shoal, Spring 2002

Numbers of macroinvertebrate taxa/sample-summary statistics. (Anova: Single Factor) (α = 0.1)

<table>
<tr><th rowspan="2"></th><th colspan="3">Horseshoe vs Monomoy vs Tuckernuck Shoal, (2002 data)</th><th colspan="3">Water Depths</th><th colspan="2">Sediment Types</th><th colspan="2">Sand Wave Presence</th><th colspan="2">Horseshoe Shoal 2001 data vs 2002 data</th></tr>
<tr><th>Horseshoe</th><th>Tuckernuck</th><th>Monomoy</th><th>5-20ft</th><th>21-30ft</th><th>30ft+</th><th>Fine sand</th><th>Medium sand</th><th>On sand waves</th><th>Off sand waves</th><th>Summer 2001</th><th>Spring 2002</th></tr>
<tr><td>Means</td><td>9.9</td><td>7.4</td><td>10.4</td><td>7.3</td><td>12.2</td><td>8.9</td><td>10.3</td><td>5.9</td><td>6.2</td><td>10.3</td><td>8.5</td><td>9.9</td></tr>
<tr><td>n</td><td>12</td><td>11</td><td>10</td><td>12</td><td>9</td><td>12</td><td>25</td><td>8</td><td>9</td><td>24</td><td>21</td><td>12</td></tr>
<tr><td rowspan="3">P-Value*</td><td colspan="2">0.31</td><td></td><td colspan="2">0.02</td><td></td><td colspan="2">0.01</td><td colspan="2">0.004</td><td colspan="2">0.53</td></tr>
<tr><td></td><td colspan="2">0.06</td><td></td><td colspan="2">0.14</td><td colspan="2" rowspan="2"></td><td colspan="2" rowspan="2"></td><td colspan="2" rowspan="2"></td></tr>
<tr><td colspan="3">0.69</td><td colspan="3">0.29</td></tr>
</table>

* Values based on transformed data

Macroinvertebrate abundance/m^2-summary statistics. (Anova: Single Factor) (α = 0.1)

<table>
<tr><th rowspan="2"></th><th colspan="3">Horseshoe vs Monomoy vs Tuckernuck Shoal, (2002 data)</th><th colspan="3">Water Depths</th><th colspan="2">Sediment Types</th><th colspan="2">Sand Wave Presence</th><th colspan="2">Horseshoe Shoal 2001 data vs 2002 data</th></tr>
<tr><th>Horseshoe</th><th>Tuckernuck</th><th>Monomoy</th><th>5-20ft</th><th>21-30ft</th><th>30ft+</th><th>Fine sand</th><th>Medium sand</th><th>On sand waves</th><th>Off sand waves</th><th>Summer 2001</th><th>Spring 2002</th></tr>
<tr><td>Means</td><td>9,059</td><td>4,587</td><td>7,075</td><td>6,213</td><td>6,713</td><td>7,913</td><td>6,993</td><td>6,887</td><td>3,719</td><td>8,185</td><td>5,381</td><td>9,059</td></tr>
<tr><td>n</td><td>12</td><td>11</td><td>10</td><td>12</td><td>9</td><td>12</td><td>25</td><td>8</td><td>9</td><td>24</td><td>21</td><td>12</td></tr>
<tr><td rowspan="3">P-Value*</td><td colspan="2">0.20</td><td></td><td colspan="2">0.77</td><td></td><td colspan="2">0.69</td><td colspan="2">0.04</td><td colspan="2">0.11</td></tr>
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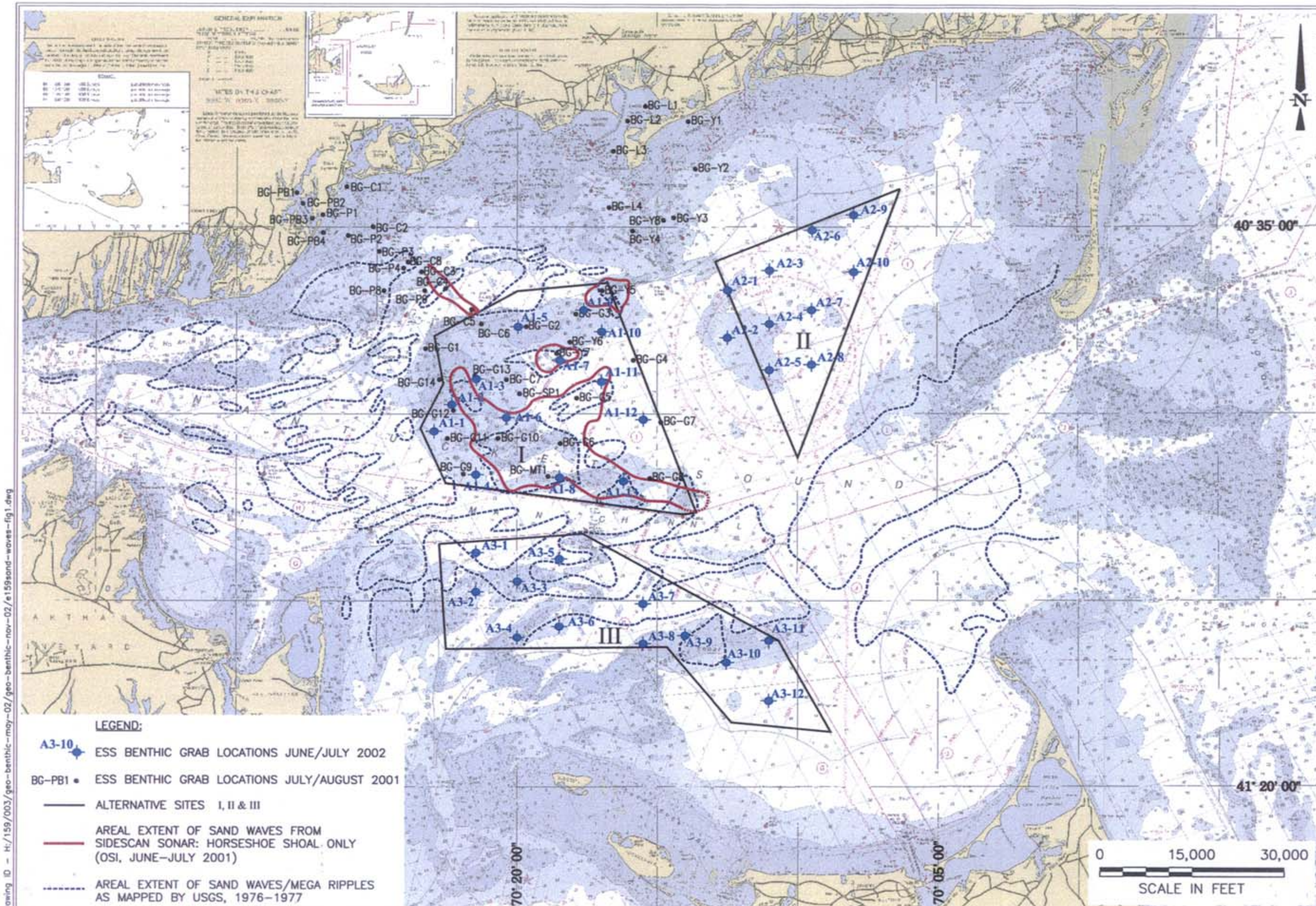
* Values based on transformed data

Figures



Distribution of Sand Waves
Cape Wind Project

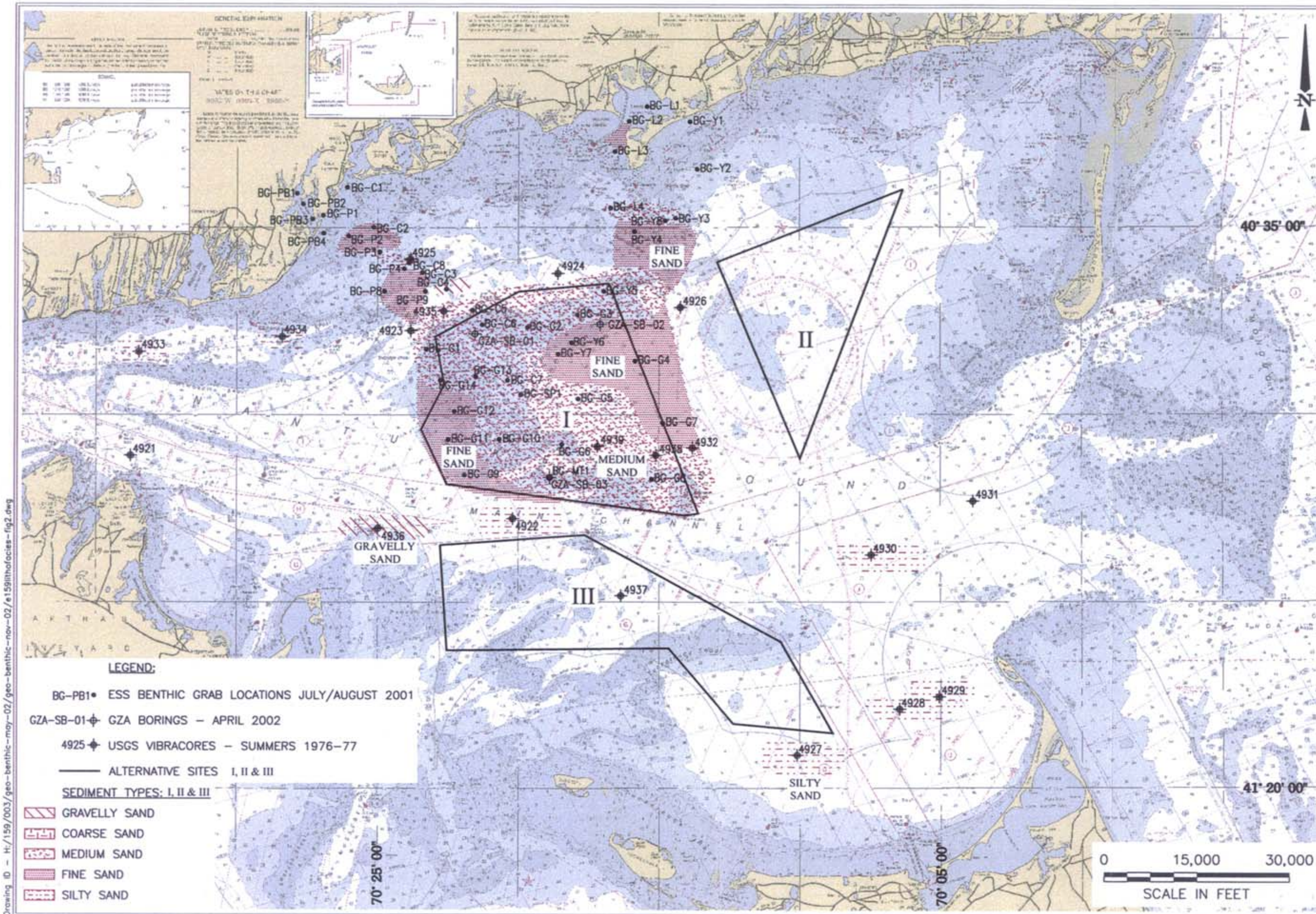
OSI Marine Geophysical Survey & Sediment Sampling Program, July/August 2001
ESS Sediment Sampling Program, June/July 2002
USGS Miscellaneous Field Study Map MF-1911, O'Hara & Oldale, 1987
NOAA Chart #13237, Nantucket Sound & Approaches

FIGURE NO.
1

PROJECT NO.
E159-005

Cape Wind
Energy for Life.

Drawing ID - H:/159/003/geo-benthic-may-02/geo-benthic-nov-02/e159sand-waves-fig1.dwg



Sediment Types Based on 2001 and Prior Data
Cape Wind Project

OSI Marine Geophysical Survey & Sediment Sampling Program, July/August 2001
USGS Miscellaneous Field Study Map MF-1911, O'Hara & Oldale, 1987
NOAA Chart #13237, Nantucket Sound & Approaches

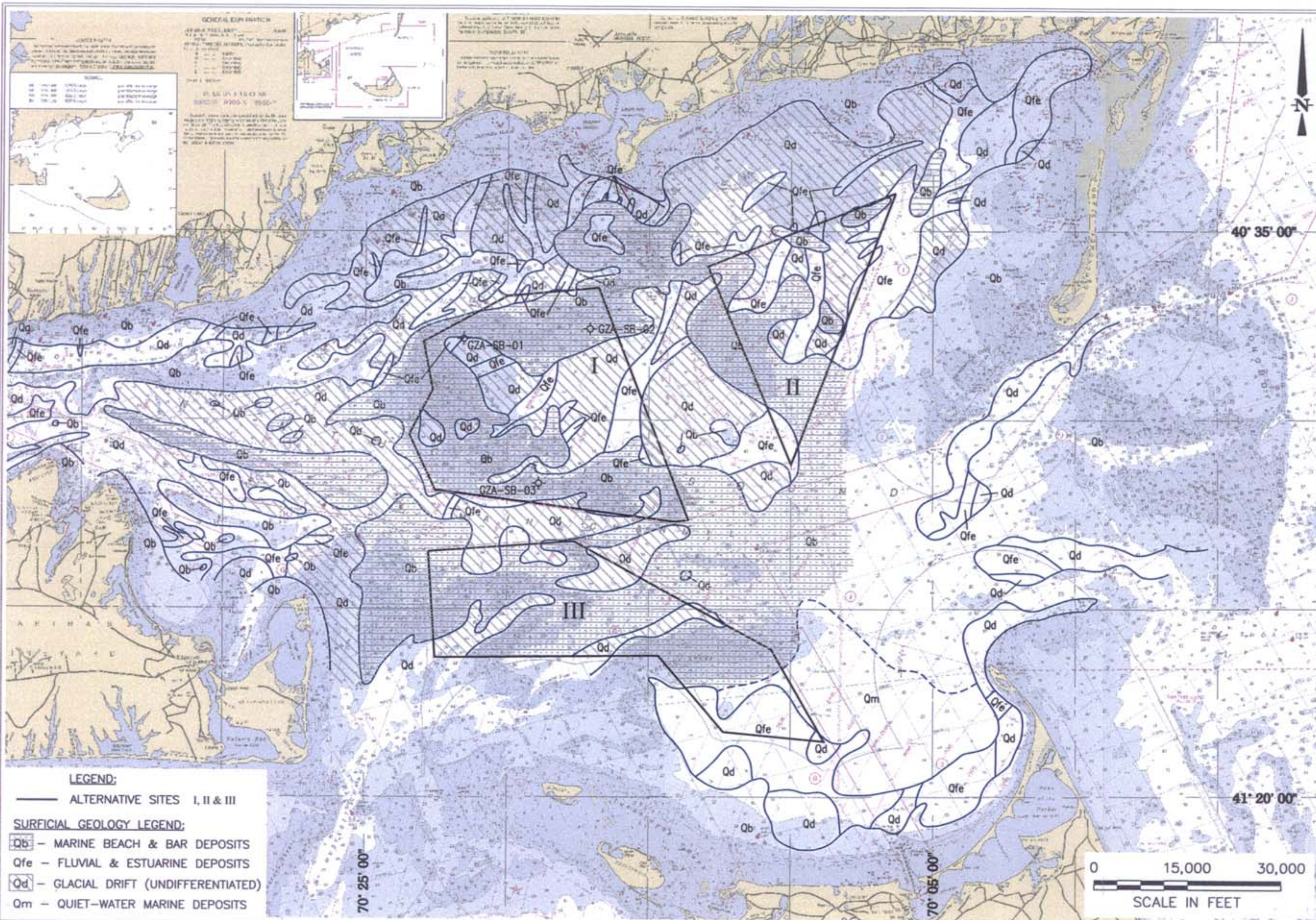
FIGURE NO.
2

PROJECT NO.
E159-005

Cape Wind
Energy for Life.

ESS

Drawing ID - H:/159/003/geo-benthic-may-02/geo-benthic-nov-02/e159lithofacies-fig2.dwg



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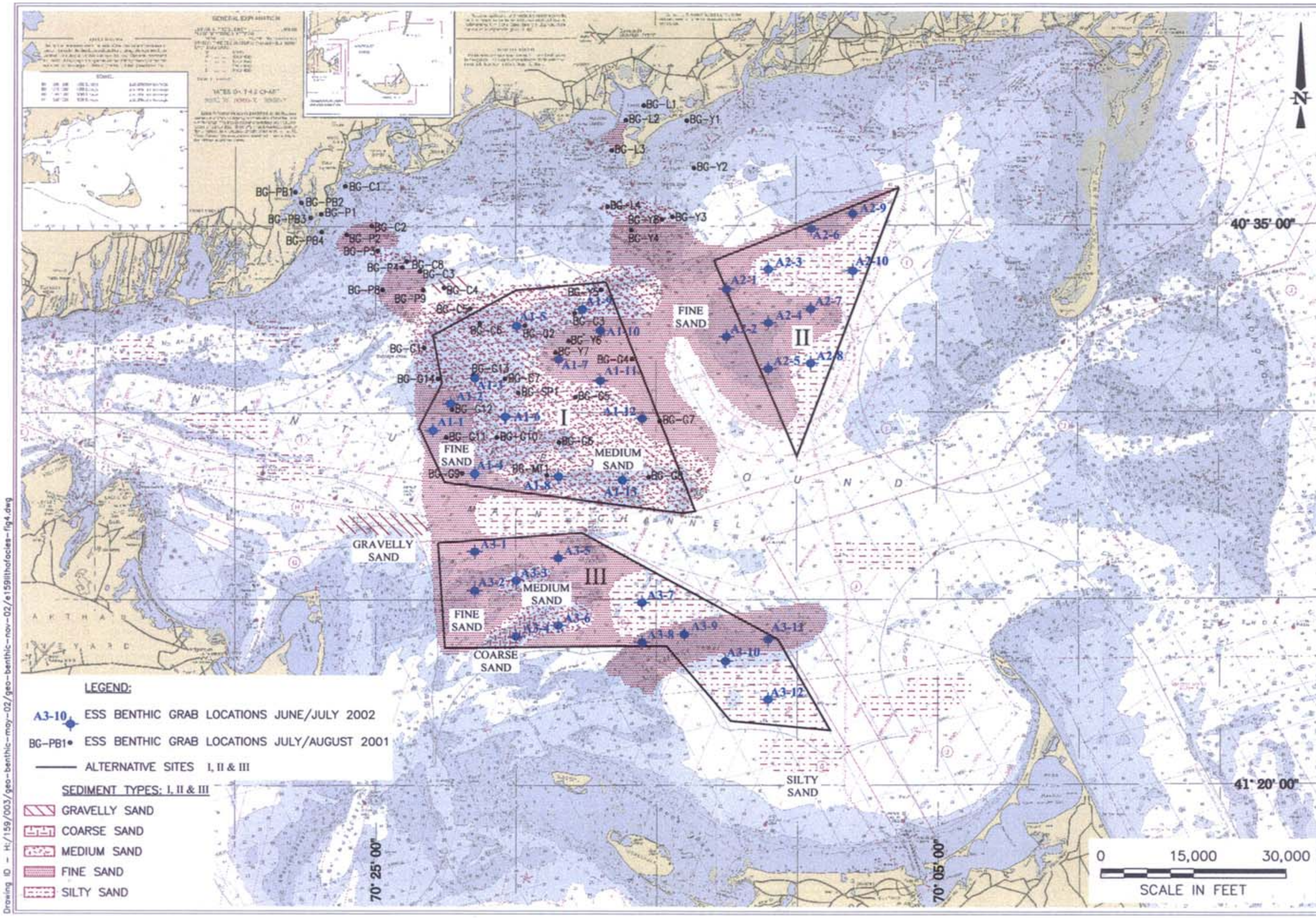
Surficial Geology
Cape Wind Project

USGS Miscellaneous Field Study Map MF-1911, O'Hara & Oldale, 1987
NOAA Chart #13237, Nantucket Sound & Approaches

FIGURE NO. 3

PROJECT NO. E159-005

Cape Wind Energy for Life.



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Surface Sediment Types Including 2002 Data
Cape Wind Project

OSI Marine Geophysical Survey & Sediment Sampling Program, July/August 2001
ESS Sediment Sampling Program, June/July 2002
USGS Miscellaneous Field Study Map MF-1911, O'Hara & Oldale, 1987
NOAA Chart #13237, Nantucket Sound & Approaches

FIGURE NO.
4

PROJECT NO.
E159-005

Cape Wind
Energy for Life.